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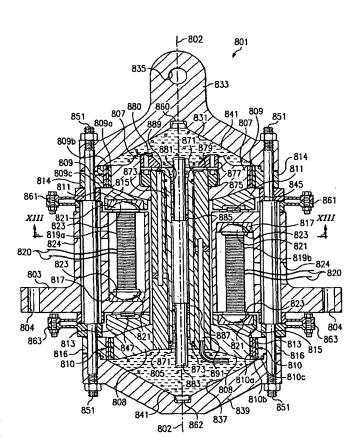
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- (71) Applicant (for all designated States except US): BELL HELICOPTER TEXTRON INC. [US/US]; P.O. Box 482, Fort Worth, TX 76101 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): SMITH, Michael, R. [US/US]; 1700 Tyler, Colleyville, TX 76034 (US). STAMPS, Frank, B. [US/US]; 4705 Mill Crossing West, Colleyville, TX 76034 (US). LEE, Taeoh [KR/US]; 503 Evelyn Court, Keller, TX 76248 (US). HEVERLY, David, E., Jr. [US/US]; 1404 Sierra Springs Drive, #610, Bedford, TX 76021 (US). PASCAL, Robert, J. [US/US]; 2714 Willing Avenue, Fort Worth, TX 76110 (US).
- (74) Agent: WALTON, James, E.; Law Offices of James E. Walton, P.L.L.C., Suite 107-328, 1169 North Burleson Boulevard, Burleson, TX 76028 (US).
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(54) Title: PIEZOELECTRIC LIQUID INERTIA VIBRATION ELIMINATOR



(57) Abstract: A tunable vibration isolator shown in figure 8 with active tuning elements having a housing, fluid chamber, and at least one tuning port. A piston is resiliently disposed within the housing. A vibration isolation fluid is disposed within the fluid chambers and the tuning ports. The tunable vibration isolator may employ either a solid tuning mass approach or a liquid tuning mass approach. The active vibration elements are preferably solid-state actuators.

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B. FIELDS SEARCHED			
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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)			
C. DOCUMENTS CONSIDERED TO BE RELEVANT			
Category *	Citation of document, with indication, where ap		Relevant to claim No.
X  Y	US 5,439,082 A (McKeown et al.) 8 August 1995 (08	.08.1995)	1, 2, 5-8, 10, 11, 13-18, 21-25, 27, 28, 41
ī			3, 9, 19, 20, 26, 29-31, 34-40, 42-44
Y	US 5,435,531 A (Smith et al.) 25 July 1995 (25.07.1995)		43,44
Y	US 5,458,222 A (Pla et al.) 17 October 1995 (17.10.1995)		9, 19, 20, 26, 29-31, 34, 37
Y	US 5,906,254 A(Schmidt et al.) 25 May 1999 (25.05.1999)		38-40, 42
Y JP 06-144376 24 May 1994 (24.05.1994)			35-37
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